

## ABSTRACT OF THE DISCLOSURE

[39] The electromigration and stress migration of Cu interconnects is significantly reduced by forming a composite capping layer comprising a layer of  $\beta$ -Ta on the upper surface of the inlaid Cu, a layer of tantalum nitride on the  $\beta$ -Ta layer and a layer of  $\alpha$ -Ta on the tantalum nitride layer. Embodiments include forming a recess in an upper surface of Cu inlaid in a dielectric layer, depositing a layer of  $\beta$ -Ta at a thickness of 25Å to 40Å, depositing a layer of tantalum nitride at a thickness of 20Å to 100Å and then depositing a layer of  $\alpha$ -Ta at a thickness of 200Å to 500Å. Embodiments further include forming an overlying dielectric layer, forming an opening therein, e.g., a via opening or a dual damascene opening, lining the opening with  $\alpha$ -Ta, and filling the opening with Cu in electrical contact with the underlying inlaid Cu.